



**Title of Investigation:**

Case Studies of Middle School Children's Scientific Inquiries

**Principal Investigator:**

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**Other In-house Members of Team:**

Lubna Rana (Code 602)

**Other External Collaborators:**

David Hammer and Elizabeth Miller, (University of Maryland, College Park)

**Initiation Year:**

FY 2005

**Aggregate Amount of Funding Authorized in FY 2004 and Earlier Years:**

\$0

**Funding Authorized for FY 2005:**

\$15,000

**Actual or Expected Expenditure of FY 2005 Funding:**

Contracts: \$15,000 to David Hammer, University of Maryland

**Status of Investigation at End of FY 2005:**

Completed in FY 2005

**Purpose of Investigation:**

Current practices for NASA Education Specialists (NESs) are structured almost exclusively around content delivery—bringing NASA content to the schools and helping teachers to deliver that content to students. The purpose of this project was to introduce NASA's specialists to new approaches for educating science teachers. These approaches centered around attention and response to student thinking—in other words, teaching teachers how to identify, interpret, and respond to the beginnings of science in what children say and do. The emphasis shifts from science as a body of information that NASA imparts, to science as a kind of intellectual activity into

which NASA can help students enter. The project focuses on training teachers to recognize and cultivate children's productive thinking.

### **Accomplishments to Date:**

The project team (Hammer, Miller, Rana) met with NASA Education Specialists every other Monday afternoon from January through May 2005, and then again on August 8 and 9.

During these meetings, we discussed topics in science and we analyzed student thinking, both in video and written case studies of elementary through high school classes. The two are closely related: The abilities to hear, understand, and respond to students' ideas and reasoning overlap with the abilities to engage in scientific argumentation.

The science conversations focused on non-traditional, conceptual questions that the NESs had not heard before. We took an approach to thinking about questions that did not involve the authority of someone who already knows the answer. The core purpose was to experience something more like authentic scientific inquiry and to consider what scientific inquiry entails. As a group, the NESs have far more experience with content delivery than with science as intellectual activity, and at the outset of the project, they were not accustomed to conversing in this way. The project leaders had not fully anticipated the need for work in this respect, but the group made progress.

The analyses of student thinking involved close examination of written and video data from student conversations—something the project leaders expected would be a new kind of activity for the NESs. For many educators and scientists, it is new to consider what students say and do as *data* one can analyze. Therefore, it seemed strange to devote so much time and attention to interpreting a few minutes of classroom dialogue. Part of the progress we made was getting the NESs to see this analysis as useful, just as it is useful for geologists to spend time and attention analyzing a few rock samples. The purpose of analyzing small samples of classroom data—we call them “snippets”—is to learn to interpret students' ideas and reasoning. As with anything else, skill comes with practice. The group made progress in this activity, as well.

A final accomplishment was getting the NESs to bring in their own data from their schools. This was the purpose of the summer workshop, scheduled for August 8–10. John Weis got things started with a 50-minute video of a 7<sup>th</sup>-grade class discussion about “Newton cars.” That was the only usable data; so we canceled the third day and spent the second day talking about ideas for further work.

These ideas included starting a video library that focuses on student work and thinking with NASA materials, and (2) conducting a live, distance-learning experiment in which teachers at several sites would watch a broadcast of a lesson/discussion led by Weis or another NES. They would then discuss student thinking.

### **Planned Future Work:**

Ultimately, the purpose of the project is to change the role of NASA's education specialists. Ideally, we want them to help students learn science as intellectual activity and show teachers how to identify, interpret, and respond to the beginnings of science in what children say and do. Our

most ambitious hope was that we could get the NESs to engage groups of teachers at the Explorer Schools in these activities. Although we did not really expect it, we nonetheless hoped that this could happen in the time frame of this small project. It did not, but it is the direction for future work.

This work would constitute a fundamental shift in the methods and objectives in NASA educational outreach. We have learned that it would be feasible to develop a large-scale effort to that end, but we also have learned what that would require.

First, to make substantial progress beyond what we achieved here would require substantial institutional commitment to redesign. The NESs have difficult schedules; this represented the most serious impediment to the project. They simply did not have very much time to devote to this work. There needs to be a change in the expectations and responsibilities of the NESs, not only at Goddard, but also at Oklahoma State (where a number of NESs are formally employed). NASA also needs to place a greater emphasis on recruiting new NESs who have significant science backgrounds and can engage in independent scientific inquiry.

#### **Key Points Summary:**

**Project's innovative features:** This project introduced NASA Education Specialists to new approaches to science teacher education. The new approach emphasizes focusing teachers' attention to student thinking and helping them to identify, interpret, and respond to the beginnings of science in what children say and do.

**Potential payoff to Goddard/NASA:** With systematic attention and effort, this approach could lead to a fundamental shift in the methods and objectives of NASA educational outreach. The approach could align NASA's education objectives with what is known from cognitive science and science education research. Developed more fully, NASA's work in education could contribute to that research.

**The criteria for success:** The first criterion for success would be evidence that the NESs have adopted these new practices in the schools. As these practices begin to take hold, the next criterion would focus on shifts in the teachers' practices. And the last criterion would concern evidence of students' achievements in learning science.

**Technical risk factors:** The principal factors inhibiting progress are the current expectations of the services that education specialists provide and the role they play in the schools.